

PART-I : PHYSICS

1) A wide vessel with a small hole at the bottom is filled with two liquids. The density and height of one liquid are ρ_1 and h_1 and that of the other are ρ_2 and h_2 ($\rho_1 > \rho_2$). The velocity of liquid coming out of the hole is :

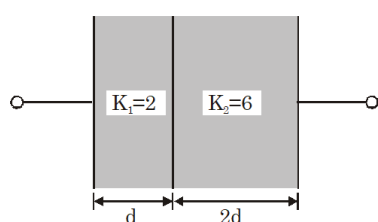
(1) $v = \sqrt{2g(h_1 + h_2)}$

(2) $v = \sqrt{2g(h_1\rho_1 + h_2\rho_2) / (\rho_1 + \rho_2)}$

(3) $v = \sqrt{2g\left(h_1 + \frac{h_2\rho_2}{\rho_1}\right)}$

(4) $v = \sqrt{2g\left(\frac{h_1\rho_1}{\rho_2} + h_2\right)}$

2) A parallel plate capacitor has two layers of dielectric as shown in figure. If this capacitor is connected across a battery, then the ratio of potential difference across the dielectric layer is



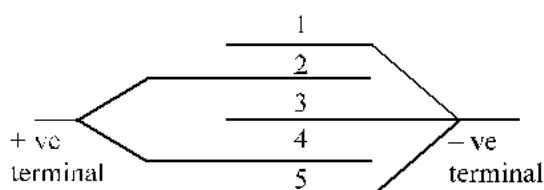
(1) $\frac{4}{3}$

(2) $\frac{1}{2}$

(3) $\frac{1}{3}$

(4) $\frac{3}{2}$

3) Five identical parallel conducting plates each of area A have separation 'd' between successive surfaces. The plates are connected to the terminal of a battery as shown in the fig. The effective capacitance of the circuit is



(1) $\frac{A\epsilon_0}{4d}$

(2) $\frac{4A\epsilon_0}{d}$

(3) $\frac{A\epsilon_0}{3d}$

(4) $\frac{3A\epsilon_0}{4d}$

4) Two masses 8kg and 4kg are suspended together by a massless spring of force constant 1000 N/m. When the masses are in equilibrium 8 kg is removed without disturbing the system. The amplitude of oscillation is :-

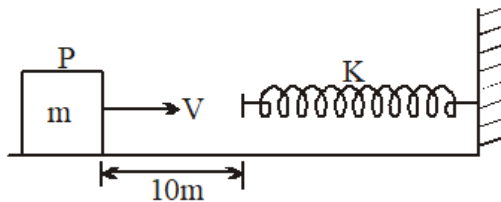
(1) 0.5m

(2) 0.08

(3) 0.4m

(4) 0.04m

5) A block of mass 1 kg kept over a smooth surface is given velocity 2 m/s towards a spring of spring constant 1 N/m at a distance of 10 m. Find after what time block will be passing through P again



(1) $(-10 - \pi)$ sec.

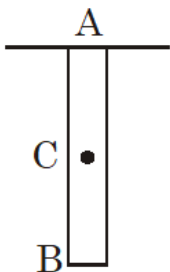
(2) 10 sec.

(3) $(10 + 2\pi)$ sec.

(4) $10 + \pi$ sec.

6) A wire of uniform cross-section is hanging vertically and due to its own weight its length changes. There is a point C on the wire such that change in length AC is equal to the change in length BC.

Points A, B & C are shown in figure. Find $\frac{AC}{BC}$.



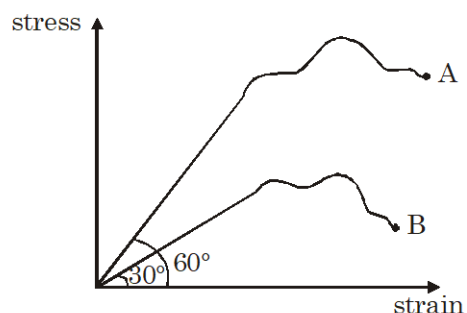
(1) 1

(2) $\sqrt{2}$

(3) $\sqrt{2} - 1$

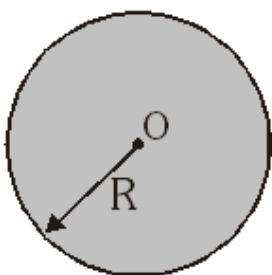
(4) $\frac{1}{\sqrt{2}}$

7) Stress-strain curve for wire A & B are shown in figure then product of young's modulus of $Y_A \times Y_B$ is :-



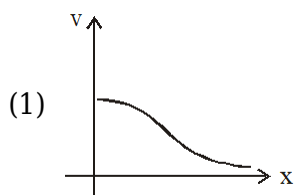
- (1) 1
- (2) 3
- (3) $\frac{1}{2}$
- (4) $\frac{1}{3}$

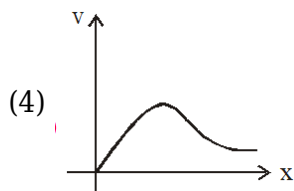
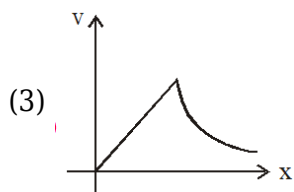
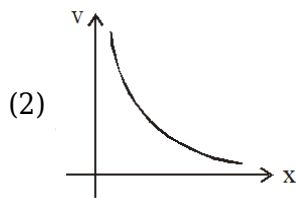
8) Volume charge density of a non-conducting sphere is varying as $\rho = \rho_0 r$ where ρ_0 is a constant and r is the distance from centre of sphere. If potential at $r = 2R$ is zero then potential at infinity will be



- (1) $\frac{\rho_0 R^3}{8\epsilon_0}$
- (2) $-\frac{\rho_0 R^3}{8\epsilon_0}$
- (3) $-\frac{\rho_0 R^3}{4\epsilon_0}$
- (4) Data insufficient

9) The electric potential due to a uniformly charged ring at a point on its axis at a distance x from centre is shown by which of following graphs.

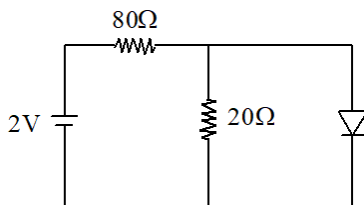




10) Which one of the following statement is false ?

- (1) The resistance of intrinsic semiconductor decreases with increase of temperature.
- (2) Pure Si doped with trivalent impurities gives a p-type semiconductor.
- (3) Majority carriers in a n-type semiconductor are holes .
- (4) Minority carriers in a p-type semiconductor are electrons.

11) In the circuit shown, the current through the ideal diode is :-

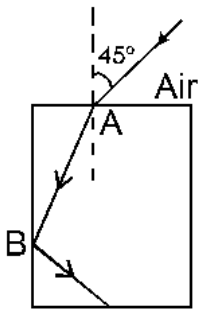


- (1) 75 mA
- (2) 20 mA
- (3) 100 mA
- (4) 25 mA

12) Two mediums I & II are separated by a plane surface having speed of light 2×10^8 m/s and 2.4×10^8 m/s respectively. What is the critical angle for a ray going from I medium to II ?

- (1) $\sin^{-1} \left(\frac{1}{2} \right)$
- (2) $\sin^{-1} \left(\frac{5}{6} \right)$
- (3) $\sin^{-1} \left(\frac{5}{12} \right)$
- (4) $\sin^{-1} \left(\frac{1}{\sqrt{2}} \right)$

13) A ray of light is incident from air to a glass rod at point A the angle of incidence being 45° . The minimum value of refractive index of the material of the rod so that T.I.R. takes place at B is :-



- (1) $\sqrt{3/2}$
- (2) $\sqrt{4/3}$
- (3) $\sqrt{5/4}$
- (4) $\sqrt{2}$

14) Two coherent radio-frequency point sources separated by 2.0 m are radiating in phase with $\lambda = 1.0\text{m}$. A detector move in a circular path of large radius around the two sources in a plane containing them. The number of maximum detected by the detector is.

- (1) 8
- (2) 10
- (3) 12
- (4) 14

15) Four sources of sound each of sound level 10dB are sounded together, the resultant intensity level will be :-

- (1) 40 dB
- (2) 26 dB
- (3) 16 dB
- (4) 13 dB

16) Consider an YDSE that has different slits width, as a result, amplitudes of waves from two slits are A and 2A, respectively. If I_0 be the maximum intensity of the interference pattern, then intensity of the pattern at a point where phase difference between waves is ϕ , is

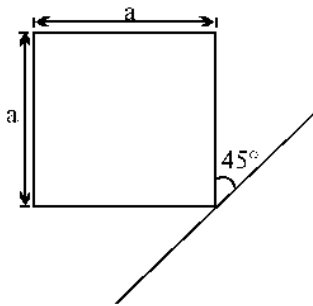
- (1) $I_0 \cos^2 \phi$
- (2) $\frac{I_0}{3} \sin^2 \frac{\phi}{2}$
- (3) $\frac{I_0}{9} [5 + 4 \cos \phi]$
- (4) $\frac{I_0}{9} [5 + 8 \cos \phi]$

17) A thin perfectly transparent glass sheet of thickness t and refractive index μ is pasted on one of the two identical slits. If the intensity of light at the centre of the screen is I_0 in the absence of glass

sheet, the intensity at O as a function of thickness t of the glass plate is

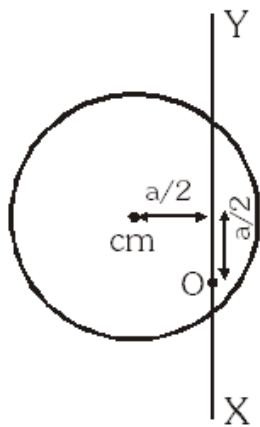
- (1) $I_0 \cos \left(\frac{\mu t}{\lambda} \right)$
- (2) $I_0 \cos^2 \left(\frac{\mu t}{\lambda} \right)$
- (3) $I_0 \cos^2 \left(\frac{\pi(\mu - 1)t}{\lambda} \right)$
- (4) $I_0 \cos \left(\frac{\pi(\mu - 1)t}{\lambda} \right)$

18) The moment of inertia of a thin sheet of mass M of the given shape about the specified axis is



- (1) $\frac{7}{12} Ma^2$
- (2) $\frac{5}{12} Ma^2$
- (3) $\frac{1}{3} Ma^2$
- (4) $\frac{1}{12} Ma^2$

19) The diagram shows a uniform disc of mass M & radius ' a '. If the moment of inertia of the disc about the axis XY is I , its moment of inertia about an axis through O and perpendicular to the plane of the disc is



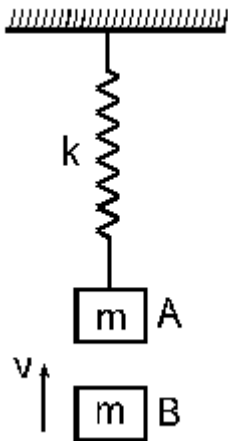
- (1) $\frac{4}{3} Ma^2$

(2) $I + \frac{1}{4}Ma^2$

(3) $2I$

(4) $\frac{I}{2}$

20) Block 'A' is hanging from a vertical spring and is at rest. Block 'B' strikes the block 'A' with velocity 'v' and sticks to it. Then the value of 'v' for which the spring just attains natural length is:



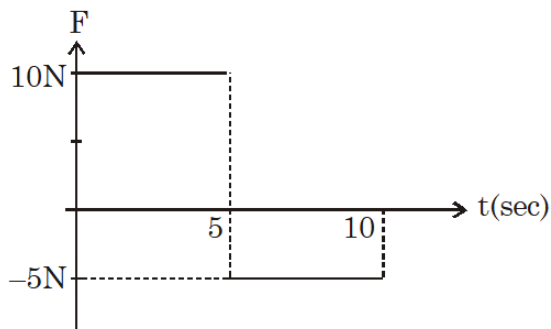
(1) $\sqrt{\frac{60mg^2}{k}}$

(2) $\sqrt{\frac{6mg^2}{k}}$

(3) $\sqrt{\frac{10mg^2}{k}}$

(4) None of these

21) A particle of mass 2kg moving with speed 2m/s is acted up by force F , whose variation is shown in the graph. What will be the maximum speed of particle during the subsequent motion:-



(1) 25 m/s

(2) 27 m/s

(3) 20 m/s

(4) 23 m/s

22) Two blocks A and B are connected by a light spring. They are of masses 1.0 kg and 2.0 kg respectively. The system is placed on a smooth horizontal plane and the block B is pulled by a horizontal force of 10 N.

At the instant shown in the figure acceleration of the block A is observed to be 2.0 m/s^2 towards right. Acceleration of the block B at this instant is



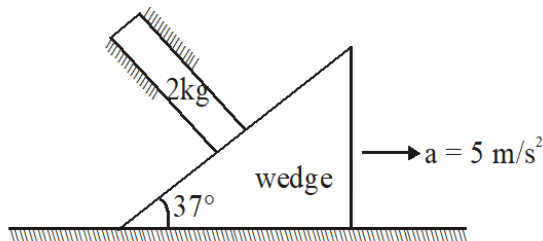
(1) 0.0 m/s^2

(2) 2.0 m/s^2

(3) 3.0 m/s^2

(4) 4.0 m/s^2

23) In the situation shown a block of mass 2 kg is constrained to move perpendicular to the incline plane of the wedge. If the wedge is moving with acceleration 5 m/s^2 horizontally, the normal force between block and wedge is (assume no friction)



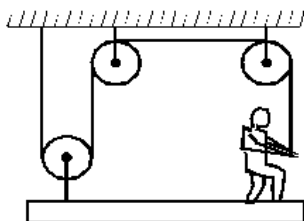
(1) 10 N

(2) 12 N

(3) 8 N

(4) 16 N

24) A 50 kg person stand on a 25 kg platform. He pulls on the rope which is attached to the platform via the frictionless pulleys as shown in the figure. The platform moves upwards at a steady rate if the force with which the person pulls the rope is



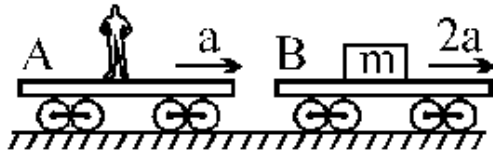
(1) 500 N

(2) 250 N

(3) 25 N

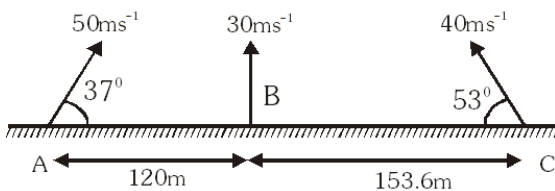
(4) None

25) Two trolley A and B are moving with accelerations a and $2a$ respectively in the same direction. To an observer in trolley A, the magnitude of pseudo force acting on a block of mass m on the trolley B is



- (1) zero
- (2) ma
- (3) $2ma$
- (4) None

26) Three balls A, B and C are thrown from three points lying on the same horizontal plane as shown in figure.



Which of the following statement is incorrect ?

- (1) Time of flights are same for three balls
- (2) Three balls meet after 3 second if all the balls are projected simultaneously
- (3) The balls can never meet if all the balls are projected simultaneously
- (4) None of these

27) Figure shows a boy on a horizontal platform A on a smooth horizontal surface, holding a rope attached to a box B. Boy pulls the rope with a constant force of 50 N. (boy does not slip over the platform). The combined mass of platform A and boy is 250 kg and that of box B is 500 kg. The velocity of A relative to the box B, 5 s after the boy on A begins to pull the rope, will be



- (1) 1 m/s
- (2) 1.5 m/s
- (3) 2 m/s
- (4) 0.5 m/s

28) A lift A is accelerating vertically upwards with acceleration 5 m/s^2 and another lift is accelerating downwards with acceleration

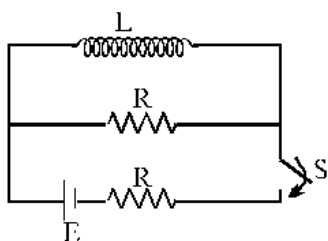
5 m/s^2 . A coin is released from rest (with respect to lift) from some height in lift A. At that instant velocity of lift A is 8 m/s vertically upwards & velocity of lift B is 12 m/s vertically downwards. Then velocity & acceleration of coin with respect to lift B at that instant will be respectively :-

- (1) 20 m/s , 20 m/s^2
- (2) 4 m/s , 15 m/s^2
- (3) 4 m/s , 15 m/s^2
- (4) 20 m/s , 5 m/s^2

29) When the current in a certain inductor coil is 5.0 A and is increasing at the rate of 10.0 A/s , the potential difference across the coil is 140 V . When the current is 5.0 A and decreasing at the rate of 10.0 A/s , the potential difference is 60 V . The self inductance of the coil is :

- (1) 2 H
- (2) 4 H
- (3) 8 H
- (4) 12 H

30) In the circuit shown in figure switch S is closed at time $t = 0$, current through inductor after long time of closing of switch.



- (1) $\frac{E}{R}$
- (2) $\frac{E}{2R}$
- (3) Zero
- (4) None

PART-II : CHEMISTRY

1) Which of the following species are isotopic as well as isoelectronic

- (1) $^{40}\text{Ca}^{+2}$, ^{40}Ar
- (2) $^{39}\text{K}^+$, $^{40}\text{K}^+$
- (3) $^{24}\text{Mg}^{+2}$, ^{25}Mg
- (4) ^{23}Na , $^{24}\text{Na}^+$

2) Choose the correct order of lattice enthalpy of LiCl , LiF , NaCl & NaF :

- (1) $\text{LiF} > \text{NaCl} > \text{NaF} > \text{LiCl}$
- (2) $\text{LiF} > \text{LiCl} > \text{NaF} > \text{NaCl}$
- (3) $\text{LiF} > \text{NaF} > \text{NaCl} > \text{LiCl}$
- (4) $\text{LiCl} > \text{LiF} > \text{NaF} > \text{NaCl}$

3) In the given following, the incorrect statement is:

- (1) N_2O_3 is pale blue liquid and is acidic oxide in nature
- (2) NO_2 (gas) is paramagnetic while in its solid state is a diamagnetic
- (3) Aqua regia dissolves, Pt and Au metal and liberate O_2 gas.
- (4) With excess of Chlorine gas, NH_3 forms explosive compound NCl_3

4) Which of the following precipitate is insoluble in excess of NH_4OH

- (1) $\text{Zn}(\text{OH})_2$
- (2) $\text{Cd}(\text{OH})_2$
- (3) $\text{Fe}(\text{OH})_3$
- (4) $\text{Cu}(\text{OH})_2$

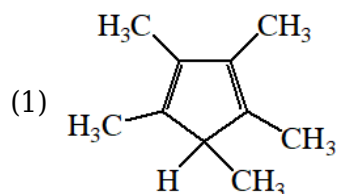
5) Select the pair of hydrated isomer in which both hydrate isomer have two stereoisomeric form.

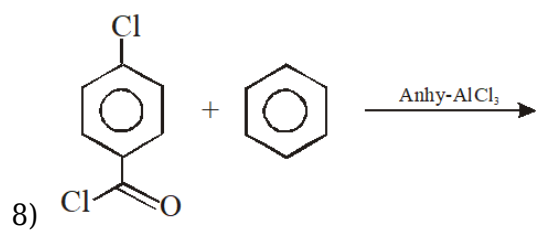
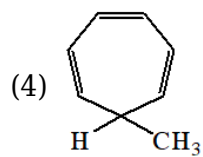
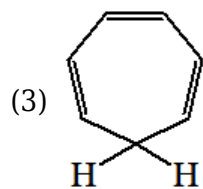
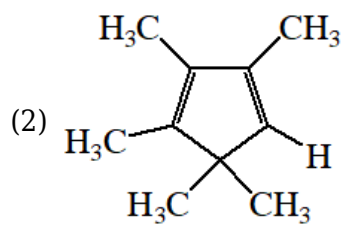
- (1) $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})](\text{NO}_3)_3$ and $[\text{Co}(\text{NH}_3)_5(\text{NO}_3)](\text{NO}_3)_2 \cdot \text{H}_2\text{O}$
- (2) $[\text{Pt}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Br}_2$ and $[\text{Pt}(\text{H}_2\text{O})_4\text{Br}_2]\text{Cl}_2$
- (3) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl} \cdot \text{H}_2\text{O}$
- (4) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ and $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$

6) Which of the following is **correct** ?

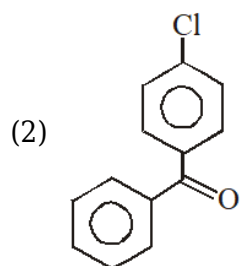
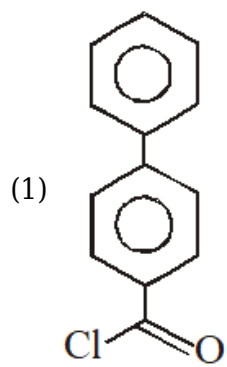
- (1) CrO_3 has peroxide bond in the structure.
- (2) Heating $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ produces Cr_2O_3 along with O_2 .
- (3) Acidification of $\text{K}_2\text{Cr}_2\text{O}_7$ turns it yellow.
- (4) Cl_2 is liberated in little amount when $\text{K}_2\text{Cr}_2\text{O}_7$, KCl and conc. H_2SO_4 are heated together.

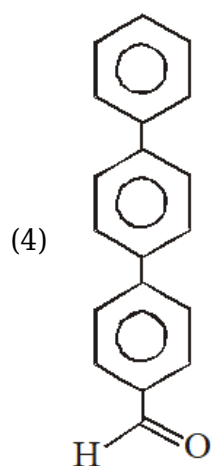
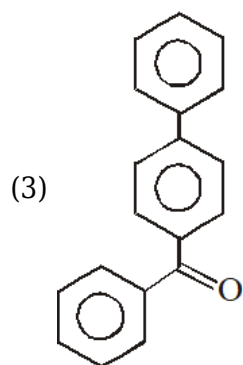
7) Which one of the hydrocarbon is the most acidic



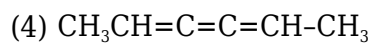
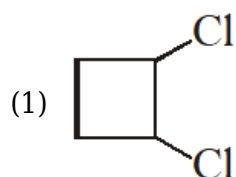


Major product of reaction -

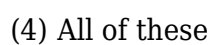
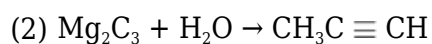
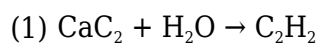




9) Which of the following compound can not show G.I. (Geometrical isomerism) :

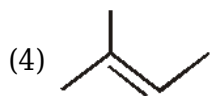
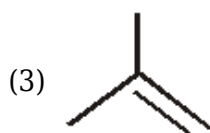


10) Which of the following reaction not gives alkyne :



11) Which alkene gives same product on reaction with $\text{HBr} / \text{CCl}_4$ and HBr / ROOR separately?





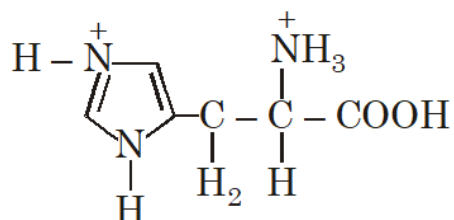
12) Vitamin E is also called ?

- (1) Cyanocobalamin
- (2) Tocopherol
- (3) Lactoflavin
- (4) Ascorbic acid

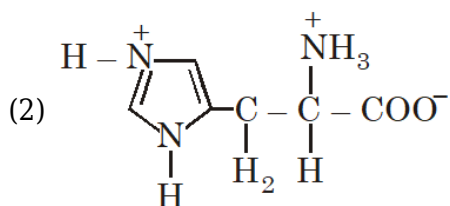
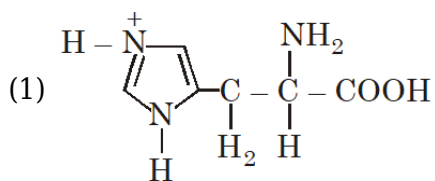
13) Which of the following statement about DNA is not correct?

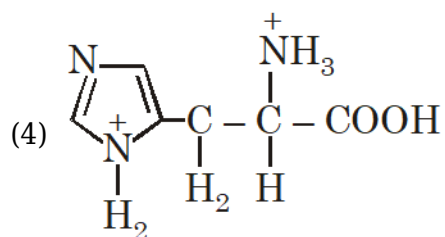
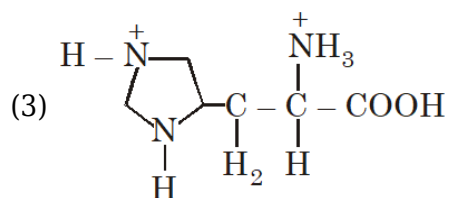
- (1) It has a double helix structure
- (2) It undergoes replication
- (3) The two strands of a DNA are exactly similar.
- (4) It contains the 2-deoxyribose pentose sugar

14) Histidine a heterocyclic amino acid has following structure at pH < 1.82



at pH > 1.82, it should have which structure :

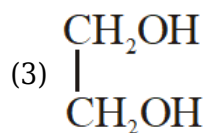
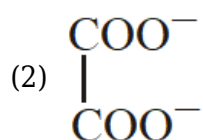
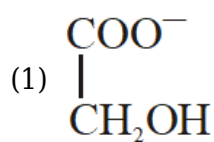
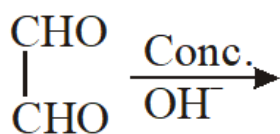




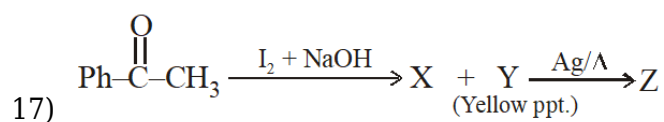
15) Which of the following pairs give positive Tollen's test?

- (1) Glucose, Sucrose
- (2) Glucose, Fructose
- (3) Hexanol, acetophenone
- (4) Fructose, sucrose

16) The product of the reaction :



(4) Both (1) & (2)



Identify 'X' :

- (1) CHI_3
- (2) $\text{HC} \equiv \text{CH}$
- (3) $\text{CH}_2 = \text{CH}_2$

(4) Ph-COONa

18) The uncertainty in position of an electron is equal to its de-broglie wavelength, the minimum percentage error in its measurement of velocity is nearly -

- (1) 15%
- (2) 8%
- (3) 26%
- (4) 37%

19) The rate constant K_1 of a reaction is found to be double to that of rate constant K_2 of another reaction. The relationship between corresponding activation energies of the two reactions at same temperature (E_1 and E_2) can be represented as -

- (1) $E_1 > E_2$
- (2) $E_1 < E_2$
- (3) $E_1 = E_2$
- (4) Nothing can be predict regarding comparision of activation energies

20) During electrolysis of H_2O , volume of H_2 and O_2 are released in the ratio -

- (1) 2 : 16
- (2) 16 : 1
- (3) 8 : 1
- (4) 2 : 1

21) 0.2 M 1 litre solution of $[Pt(NH_3)_4Br_2]Cl_2$ is treated with excess of $AgNO_3$. It produces

- (1) 0.4 mole white ppt
- (2) 0.4 mole yellow ppt
- (3) 0.2 mole yellow ppt
- (4) 0.4 mole white + 0.4 mole yellow ppt

22) Graph between $\log \left(\frac{x}{m} \right)$ and $\log P$ is a straight line inclined at an angle of 45° . When pressure of 0.5 atm and $\log K = 0.699$, amount of solute adsorbed for gram of adsorbent will be :

- (1) 1 gm / g adsorbent
- (2) 1.5 gm / g adsorbent
- (3) 2.5 gm / g adsorbent
- (4) 0.25 gm / g adsorbent

23) The number of unit cell in 58.5g of NaCl is nearly-

- (1) 6×10^{20}
- (2) 1.5×10^{23}

(3) 3×10^{22}

(4) 0.5×10^{24}

24) At what temperature will be average translational KE of 0.4 mol of He be the same as that of 0.3 mol of argon at 400K

(1) 700K

(2) 500K

(3) 800K

(4) 300K

25) For a given reaction rate = $K[A]^1[B]^{2/3}$; the unit of rate constant K can be given as

(1) $\text{mol}^{-2/3} \text{ litre}^{2/3} \text{ time}$

(2) $\text{mol}^{2/3} \text{ litre}^{-2/3} \text{ time}^{-1}$

(3) $\text{mol}^{-2/3} \text{ litre}^{2/3} \text{ time}^{-1}$

(4) $\text{mol}^{-2/3} \text{ litre}^{-2/3} \text{ time}^{-1}$

26) De Broglie wavelength of an electron after being accelerated by a potential difference of V volt from rest is

(1) $\frac{12.3}{\sqrt{h}} \text{ \AA}$

(2) $\frac{12.3}{\sqrt{V}} \text{ \AA}$

(3) $\frac{12.3}{\sqrt{E}} \text{ \AA}$

(4) $\frac{12.3}{\sqrt{m}} \text{ \AA}$

27) What is heat of atomisation of $\text{P}_4\text{O}_6(\text{s})$ Given heat of sublimation of P_4O_6 is x kJ/mol & P-O bond energy is y kJ/mol.

(1) $x + 6y$

(2) $x + y$

(3) $x + 8y$

(4) $x + 12y$

28) An ideal gas at constant temperature expands its

(1) internal energy increases

(2) internal energy decreases

(3) internal energy remains same

(4) entropy increases and then decreases

29) A liquid solution is formed by mixing 10 moles of aniline with 20 moles of phenol at a

temperature T. If vapour pressure of pure phenol and pure aniline are 90 & 87 mm of Hg respectively at the temperature T, then identify what could be the possible value of vapour pressure of the solution ?

- (1) 89 mm
- (2) 80 mm
- (3) 93 mm
- (4) 90 mm

30) Identify the statement which is correct ?

- (1) Milk is an example of homogeneous solution.
- (2) Adsorption process is entropy driven process.
- (3) In case of CsCl crystal, 8 Cs^+ ions occupy next nearest neighbour position to each Cs^+ ion.
- (4) Aqueous solution of ethylene glycol can be used as antifreeze.

PART-III : MATHEMATICS

1) The expression in the vector form for the point $\vec{r}_1$ of intersection of the plane $\vec{r} \cdot \vec{n} = d$ and the perpendicular line $\vec{r} = \vec{r}_0 + t\vec{n}$ where t is a parameter given by -

- (1) $\vec{r}_1 = \vec{r}_0 + \left(\frac{d - \vec{r}_0 \cdot \vec{n}}{n^2} \right) \vec{n}$
- (2) $\vec{r}_1 = \vec{r}_0 - \left(\frac{\vec{r}_0 \cdot \vec{n}}{n^2} \right) \vec{n}$
- (3) $\vec{r}_1 = \vec{r}_0 - \left(\frac{\vec{r}_0 \cdot \vec{n} - d}{|\vec{n}|} \right) \vec{n}$
- (4) $\vec{r}_1 = \vec{r}_0 + \left(\frac{\vec{r}_0 \cdot \vec{n}}{|\vec{n}|} \right) \vec{n}$

2) Let $f(x) = 5 - 4 \left(\sqrt[3]{x-2} \right)^2$, then at $x = 2$ the function $f(x)$ -

- (1) attains a minimum value
- (2) attains a maximum value
- (3) attains neither a minimum value nor maximum value
- (4) is undefined

3) The equation of the plane containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and the point (0, 7, -7) is-

- (1) $x + y + z = 1$
- (2) $x + y + z = 2$
- (3) $x + y + z = 0$

(4) none of these

4) Let L_1 be the line $\vec{r}_1 = 2\hat{i} + \hat{j} - \hat{k} + \lambda (\hat{i} + 2\hat{k})$ and let L_2 be the line $\vec{r}_2 = 3\hat{i} + \hat{j} + \mu (\hat{i} + \hat{j} - \hat{k})$.

Let π be the plane which contains the line L_1 and is parallel to L_2 . The distance of the plane π from the origin is -

(1) $\sqrt{2/7}$

(2) $1/7$

(3) $\sqrt{6}$

(4) none of these

5) P, Q have position vectors $\vec{a}$ & $\vec{b}$ relative to the origin 'O' & X, Y divide $\vec{PQ}$ internally and externally respectively in the ratio 2 : 1. Vector $\vec{XY} =$

(1) $\frac{3}{2} (\vec{b} - \vec{a})$

(2) $\frac{4}{3} (\vec{a} - \vec{b})$

(3) $\frac{5}{6} (\vec{b} - \vec{a})$

(4) $\frac{4}{3} (\vec{b} - \vec{a})$

6) Sum of series $\sum_{n=0}^{\infty} \cot^{-1}(2^{n+1} + 2^{-n})$ is equal to-

(1) $\frac{\pi}{8}$

(2) $\frac{\pi}{4}$

(3) $\frac{\pi}{2} + \tan^{-1} 2$

(4) $\frac{\pi}{4} + \cot^{-1} 2$

7) If ABCDEF is a regular hexagon with $\vec{AB} = \vec{a}$ and $\vec{BC} = \vec{b}$, then $\vec{CE}$ equals -

(1) $\vec{b} - \vec{a}$

(2) $-\vec{b}$

(3) $\vec{b} - 2\vec{a}$

(4) none of these

8) If z_1 and z_2 are two positions of P(z) on $|z| = 2$ for which $||z-1-i|-|z-1+i||$ is maximum then $z_1 z_2$ is equal to :-

(1) 4

(2) $4i$

(3) $2\sqrt{2}(1 + i)$

(4) $2\sqrt{2}(1 - i)$

9) If a point P moves such that its distance from line $y = \sqrt{3}x - 7$ is same as its distance from $(3\sqrt{3}, 2)$, then the area of the curve, described by p, enclosed between the coordinate axes is (in square units) -

(1) $\frac{5\sqrt{3}}{2}$

(2) $5\sqrt{3}$

(3) $\frac{25\sqrt{3}}{2}$

(4) $25\sqrt{3}$

10) If the slope of tangent to curve $y = e^x \cos x$ possess local maxima at $x = a$, then 'a' equals -

(1) $\frac{3\pi}{2}$

(2) π

(3) $\frac{\pi}{2}$

(4) 0

11) Two complex numbers z_1 & z_2 have purely imaginary product & purely real quotient. Number of ordered pairs (z_1, z_2) such that

$|z_1| = |z_2| = 1$ are :-

(1) 2

(2) 4

(3) 6

(4) 8

12) The values of 'a' for which both roots of the equation $(a + 1)x^2 - 3ax + 4a = 0$ are greater than unity -

(1) $\left[-\frac{16}{7}, 0\right)$

(2) $\left[-\frac{16}{7}, -1\right)$

(3) $\left(-\frac{1}{2}, 0\right]$

(4) $\left(-1, -\frac{1}{2}\right)$

13) If $\frac{1}{(b+c)} \log x, \log x^{\frac{1}{(c+a)}}, \log x^{(a+b)^{-1}}$ are in A.P., then which of following is correct ($x > 0$) :-

- (1) a, b, c are in A.P.
 (2) a, b, c are in G.P.
 (3) a^2, b^2, c^2 are in A.P.
 (4) a, b, c are in H.P.

14) $\int_1^{e^{35}} \frac{\pi \sin(\pi \ln x)}{x} dx$ is equal to -

- (1) 2
 (2) - 2
 (3) $\frac{2}{\pi}$
 (4) 2π

15) If a, b, c are non-zero numbers in A.P., then $\frac{1}{a} - bc, \frac{1}{b} - ca, \frac{1}{c} - ab$ are in -

- (1) A.P.
 (2) G.P.
 (3) H.P.
 (4) none of these

16) If $f(x) = \int_1^x \frac{\tan^{-1} x}{x} dx$, then the value of $\frac{f(e^3) - f(e^{-3})}{f(e) - f(e^{-1})}$ is equal to-

- (1) 1
 (2) 3
 (3) 6
 (4) 8

17) If $(a \sec \theta, b \tan \theta)$ and $(a \sec \phi, b \tan \phi)$ are the ends of a focal chord of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, then $\tan \frac{\theta}{2} \tan \frac{\phi}{2}$ equal to -

- (1) $\frac{e-1}{e+1}$
 (2) $\frac{1-e}{1+e}$
 (3) $\frac{1+e^2}{1-e}$
 (4) $\frac{e+1}{e-1}$

18) If $x = a + bi$ is a complex number such that $x^2 = 3 + 4i$ and $x^3 = 2 + 11i$ where $i = \sqrt{-1}$, then (a

+ b) equal to -

- (1) 2
- (2) 3
- (3) 4
- (4) 5

19) India and Pakistan play a 5 match test series of hockey, the probability that India wins at least three matches is -

- (1) $\frac{1}{2}$
- (2) $\frac{3}{5}$
- (3) $\frac{4}{5}$
- (4) $\frac{5}{16}$

20) If the normal at P(8,2) on the curve $xy = 16$ meets the curve again at Q. The angle subtended by PQ at origin is $\tan^{-1} \left(\frac{\lambda_1}{\lambda_2} \right)$ where λ_1 & λ_2 are relatively prime, then $\lambda_1 - 2\lambda_2 =$

- (1) 7
- (2) 3
- (3) 14
- (4) 2

21) A point P moves outside a circle C_1 of radius 2 and inside another concentric circle C_2 of radius 4. The chance that the point P is nearer to C_1 , then to C_2 is equal to

- (1) $\frac{9}{16}$
- (2) $\frac{5}{12}$
- (3) $\frac{1}{4}$
- (4) $\frac{3}{4}$

22) If $g(x) = 3 + x + e^x$ then $g^{-1}(4) =$

- (1) $\log_2 4$
- (2) $\log_2 2$
- (3) $\log_2 1$
- (4) cannot be determine

23) $\int \left(2x + \frac{1}{x}\right) \cos \frac{1}{x} dx$ is equal to-

(1) $x^2 \cos \frac{1}{x} - x \sin \frac{1}{x} + C$

(2) $x^2 \sin \frac{1}{x} - x \cos \frac{1}{x} + C$

(3) $x^2 \cos \frac{1}{x} + x \sin \frac{1}{x} + C$

(4) $x^2 \sin \frac{1}{x} + x \cos \frac{1}{x} + C$

24) The function $y = \frac{ax + b}{cx + d}$, $c \neq 0$ coincides with its inverse then :

(1) $a = d$

(2) $a = -b$

(3) $a = c$

(4) $a = -d$

25) $\int \frac{x^2(x \sec^2 x + \tan x)}{(x \tan x + 1)^2} dx$ is

(1) $\frac{x^2}{1 + x \tan x} + 2 \ln |x \sin x - \cos x| + C$

(2) $\frac{-x^2}{1 + x \tan x} - 2 \ln |x \sin x - \cos x| + C$

(3) $\frac{-x^2}{1 + x \tan x} + 2 \ln |x \sin x + \cos x| + C$

(4) $\frac{x^2}{1 + x \tan x} - 2 \ln |x \sin x + \cos x| + C$

26) If the parabola $y = (p - q)x^2 + (q - r)x + (r - p)$, touches the x-axis in the interval (0, 3) then $px + qy + r = 0$

(1) always passes through a fixed point

(2) represents the family of parallel lines

(3) is always parallel to $y = 2x$

(4) none of these

27) The value of $\int \{ \cos(\log x) + \sin(\log x) \} dx$ is

(1) 0

(2) constant

(3) $x \sin(\log x)$

(4) none of these

28) If $\vec{a} = x_1\hat{i} + x_2\hat{j} + x_3\hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + \hat{k} \forall x_1, x_2, x_3 \in \{1, 2, 3, \dots, 10\}$, then number of vectors $\vec{a}$ such that $\vec{a} \cdot \vec{b} = 0$, is -

(1) 20

(2) 40

(3) 50

(4) 55

29) The roots of the equation $\frac{d^6}{dx^6}(x^2 - 1)^6 = 0$ are-

(1) not all real

(2) all real but not distinct

(3) all real, distinct and some of them are greater than 1

(4) all real and lie between -1 and +1.

30) The number of ways in which all the letters of the word 'HADDIPPA' can be arranged, so that alike letters are always separated -

(1) 2220

(2) 1220

(3) 2020

(4) 2210

31) If $\begin{vmatrix} x & y \\ 4 & 2 \end{vmatrix} = 7$ and $\begin{vmatrix} 2 & 3 \\ y & x \end{vmatrix} = 4$, then -

(1) $x = -3, y = -\frac{5}{2}$

(2) $x = -\frac{5}{2}, y = -3$

(3) $x = 3, y = \frac{5}{2}$

(4) $x = \frac{5}{2}, y = 3$

32) If $\frac{1}{{}^5C_r} + \frac{1}{{}^6C_r} = \frac{1}{{}^4C_r}$, then r equals -

(1) 3

(2) 4

(3) 5

(4) 2

33) The determinant $\begin{vmatrix} \pi & \pi^2 & \pi^3 \\ \pi^3 & \pi & \pi^2 \\ \pi^2 & \pi^3 & \pi \end{vmatrix}$ is

- (1) zero
- (2) negative
- (3) positive
- (4) can't say

34) If the system of equation $\begin{pmatrix} 1 & -2 & 5 \\ 2 & -1 & 1 \\ 11 & -7 & p \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3 \\ 1 \\ q \end{pmatrix}$ has infinitely many solutions, then -

- (1) $p + q = 2$
- (2) $p + q = 10$
- (3) $p - q = 2$
- (4) none of these

35) If A, B & C are matrices of order 2 such that $|A| = \frac{1}{4}, |B| = 9, |C| = 2$, then $|(3AC)(2B)^{-1}|$ is equal to -

- (1) $\frac{1}{8}$
- (2) $\frac{3}{4}$
- (3) 2
- (4) 6

36) If A_i ($i = 1, 2, 3, 4$) represents all possible matrices satisfying $A_i^2 = \begin{bmatrix} 1 & 2 \\ 0 & 4 \end{bmatrix}$, then $\sum_{i=1}^4 \det(A_i)$ is equal to -

- (1) -8
- (2) 2
- (3) -2
- (4) 0

37) $\lim_{x \rightarrow \infty} [x\sqrt{x^2 + a^2} - \sqrt{x^4 + a^4}]$ is :-

- (1) 0
- (2) $\frac{a^2}{2}$

(3) a^2

(4) does not exist

38) If $y = \cos kx$ and $y_n = \frac{d^n y}{dx^n}$ for all $n \in \mathbb{N}$, then the matrix $\begin{bmatrix} y & y_1 & y_2 \\ y_8 & y_9 & y_{10} \\ y_{14} & y_{15} & y_{16} \end{bmatrix}$ is

(1) involutory

(2) orthogonal

(3) singular

(4) none of these

39) $\lim_{n \rightarrow \infty} n \left(1 + \tan^2 \left(\frac{\pi}{4n} \right) \right) \cos^3 \frac{\pi}{4n} \sin \frac{\pi}{4n} =$

(1) $\frac{\pi}{2}$

(2) $\frac{2}{\pi}$

(3) $\frac{1}{2}$

(4) none of these

40) Consider the function for $x \in [-2, 3]$,
$$f(x) = \begin{cases} \frac{x^3 - 2x^2 - 5x + 6}{x-1} & \text{if } x \neq 1 \\ -6 & \text{if } x = 1 \end{cases}$$
, then

(1) f is discontinuous at $x = 1 \Rightarrow$ Rolle's theorem is not applicable in $[-2, 3]$

(2) $f(-2) \neq f(3) \Rightarrow$ Rolle's theorem is not applicable in $[-2, 3]$

(3) f is not derivable in $(-2, 3) \Rightarrow$ Rolle's theorem is not applicable

(4) Rolle's theorem is applicable as f satisfies all the conditions and c of Rolle's theorem is $1/2$.

PART-IV(A) : ENGLISH PROFICIENCY

1) Culottes are the most popular of all other pants.

(1) Culottes are the more popular of all pants.

(2) Culottes are the most popular of all the pants.

(3) Culottes are the most popular pants of all.

(4) No change

2) Population theory given by Thomas Malthus was better than Karl Marx's.

(1) Population theory given by Thomas Malthus was more better.

(2) Population theory given by Thomas Malthus was better than Karl Marx.

(3) Population theory given by Thomas Malthus was better than Karl Marx's theory.

(4) Population theory given by Thomas Malthus was more better than Karl Marx's.

3) **DIRECTIONS : Read the below given sentences and choose the option which will be the answer to the underlined Parallel Construction error:**

In the break, Kesha was rehearsing her script, touched-up her lipstick, and had tea that made her feel confident again to face the audience.

- (1) Kesha rehearsed her script, touched-up her lipstick, and had tea
- (2) Kesha was rehearsing her script, touching-up her lipstick, and had tea
- (3) Kesha was rehearsed her script, touching-up her lipstick, and having tea
- (4) No change

4) **DIRECTIONS : Read the below given sentences and choose the option which will be the answer to the underlined Parallel Construction error:**

Selena was searching for her favourite pair of earrings in the jewellery box, under the table, and looked behind the dressing mirror, but could not find them.

- (1) in the jewellery box, the table, and looked behind the dressing mirror
- (2) in the jewellery box, under the table, and behind the dressing mirror
- (3) the jewellery box, under the table, and looked behind the dressing mirror
- (4) No change

5) **DIRECTIONS : Choose the pair of words which are related to each other same as the capitalized words given below:**

NATION:EMBLEM:: COMPANY:_____?

- (1) Name
- (2) Registration
- (3) Logo
- (4) Trademark

6) **DIRECTIONS : Choose the pair of words which are related to each other same as the capitalized words given below:**

LIBRARY:SILENCE:: POETRY:_____?

- (1) Poem
- (2) Poet
- (3) Genre
- (4) Rhyme

7) **DIRECTIONS (Q.107-108) :**Read the following passage carefully and mark the correct answer for the questions given below:

What is immediately needed today is the establishment of a World Government or an International Federation of Mankind. It is the utmost necessity of the world today, and all those persons who wish to see all human beings happy and prosperous naturally feel it keenly. Of course, at times, we all feel that many of our problems of our political, social and cultural life would come to an end if there were one Government all over the world. Travellers, businessmen, seekers of knowledge and teachers of righteousness know very well that great impediments and obstructions are faced by them when they

pass from one country to another, exchange goods, get information, and make an effort to spread their good gospel among their fellow-men. In the past religious sects divided one set of people against another, colour of the skin or construction of the body set one against the other. But today when philosophical light has exploded the darkness that was created by religious differences, and when scientific knowledge has falsified the theory of social superiority and when modern inventions have enabled human beings of all religious views and of all races and colours to come in frequent contact with one another, it is the governments of various countries that keep people of one country apart from those of another. They create artificial barriers, unnatural distinctions, unhealthy isolation, unnecessary fears and dangers in the minds of the common men who by their nature want to live in friendship with their fellow-men. But all these evils would cease to exist if there were one Government all over the world.

What will the world Government be expected to do?

- (1) It will bring about universal happiness and prosperity
- (2) It will end all wars for all time to come
- (3) It will bring about a moral regeneration of mankind
- (4) It will kill the Satan that is in man

8) Which of the following problems has not been mentioned in the passage as likely to be solved with the establishment of world Government?

- (1) Social problems
- (2) Political problems
- (3) Cultural problems
- (4) Economic problems

9) The most appropriate title of the above passage may be:

- (1) The Evils Nurtured by National Governments.
- (2) The Unity of the World.
- (3) The Need of World Government.
- (4) The Role of Religion in the Modern Times.

10) Pick out the most appropriate word exact opposite in meaning (antonym) of the following word taken from the above passage:

Prosperous

- (1) Adverse
- (2) Advanced
- (3) Retarded
- (4) Impecunious

PART-IV(B) : LOGICAL REASONING

1) Select the correct group of letters from the given options to replace the question mark in the given analogy.

HELLO : OASHV :: PARIS : ?

- (1) SWYPZ
- (2) WWYEZ
- (3) SIRAP
- (4) SWYEZ

2) Select the correct option to replace the question mark in the figure Z.

72		112		48	
9	24	14	34	6	?

- (1) 11
- (2) 216
- (3) 18
- (4) 44

3) Identify the figure that can be formed by the pieces given in the figure X.

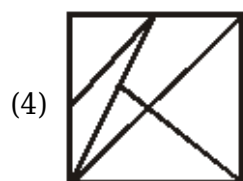
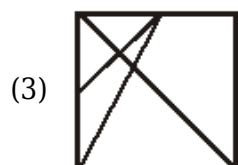
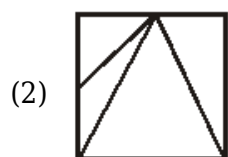
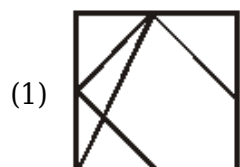
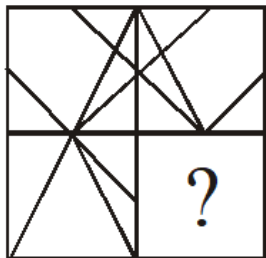


- (1)
- (2)
- (3)
- (4)

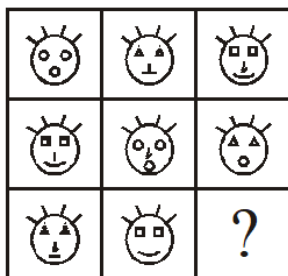
4) Choose the word which is different from the rest in the given group
 French, German, Russian, Indian, Dutch

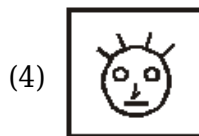
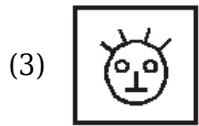
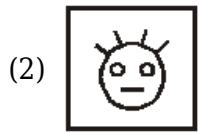
- (1) French
- (2) Indian
- (3) Dutch
- (4) Russian

5) Identify the figure to complete the given pattern.



6) Identify the figure that completes the given figure matrix.





7) Identify the figure (out of Figure A, B C and D) that most closely resembles the unfolded form of the figure S (after cutting out the shaded part).

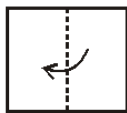


Fig. P

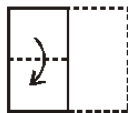


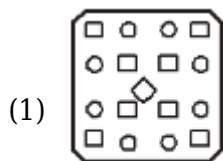
Fig. Q



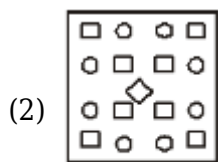
Fig. R



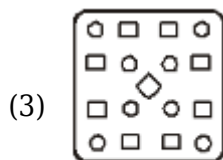
Fig. S



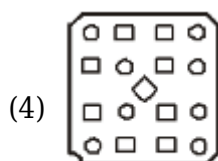
(A)



(B)

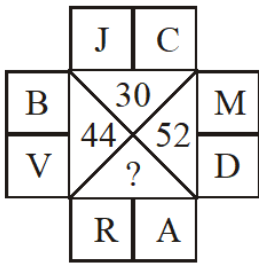


(C)



(D)

8) Select the correct option to replace the question mark in the given series.



- (1) 17
- (2) 18
- (3) 19
- (4) 20

9) Select the correct option to replace the question mark in the given series.
 B2D, I5K, ?, W6Y, D4F, K7M

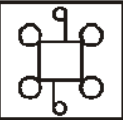
- (1) P3R
- (2) P4R
- (3) P5R
- (4) P6R

10) Identify the set of figures which follows the given rule.
 Rule : Any figure can be drawn by a single uninterrupted line without retracting.

- (1)




- (2)

- (3)




- (4)





11) Arrange the following according to dictionary arrangement.

- (1) Epitaxy
- (2) Episode
- (3) Epigene
- (4) Epitome
- (5) Epilogue

- (1) 1, 2, 3, 5

- (2) 3, 2, 5, 4, 1
 (3) 3, 5, 2, 1, 4
 (4) 5, 4, 2, 1, 3

12)

462	
84	11

64	
16	8

81	
?	9

- (1) 7
 (2) 18
 (3) 6
 (4) 14

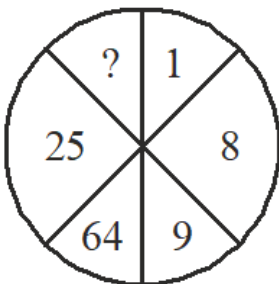
13) If @ stands for +, Δ stands for - , * stands for $\times$ then what is the value of $10 \times 4 @ 4 \times 4 \Delta 6$?

- (1) 60
 (2) 56
 (3) 50
 (4) 20

14) A man is performing yoga with his head down and legs up. His face is towards the west. In which direction will his left hand be ?

- (1) North
 (2) South
 (3) East
 (4) South west

15) Choose the missing number from among the four alternatives.



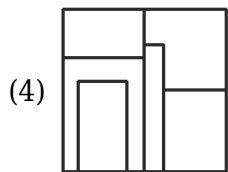
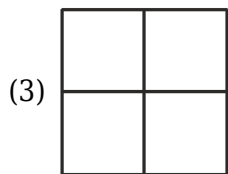
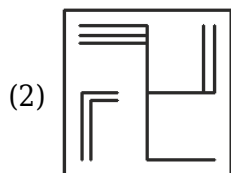
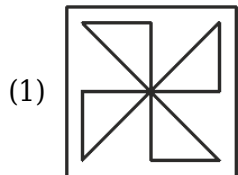
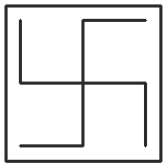
- (1) 36
 (2) 216
 (3) 26
 (4) 149

16) In a certain code language, FROG is coded as HSQH, then what will be the code for GOAT ?

- (1) UCPI

- (2) UBPH
- (3) IPCU
- (4) IQCV

17) Select the answer figure in which the question figure (X) is hidden/embedded ?



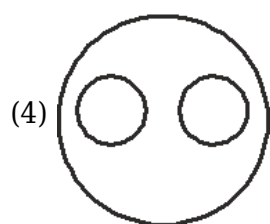
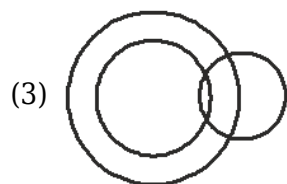
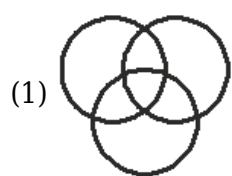
18) Sunil introduces Prakash as the son of the only brother of his fathers wife. How is Prakash related to Sunil ?

- (1) Cousin
- (2) Son
- (3) Maternal uncle
- (4) Son-in-law

19) $25 : 625 :: 35 : ?$

- (1) 1575
- (2) 875
- (3) 635
- (4) 1205

20) Choose the venn diagram which best illustrates the three classes Pen, Pencil and Stationary.



ANSWER KEYS

PART-I : PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	3	4	2	2	4	3	1	2	1	3	4	2	1	1	3	3	3	1	3	2
Q.	21	22	23	24	25	26	27	28	29	30										
A.	2	4	1	2	2	1	2	4	2	1										

PART-II : CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	2	2	3	3	3	4	1	2	3	3	2	2	3	2	2	4	4	2	4	4
Q.	51	52	53	54	55	56	57	58	59	60										
A.	1	3	2	4	3	2	4	3	2	4										

PART-III : MATHEMATICS

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	1	2	3	1	4	2	3	1	3	4	4	2	3	1	3	2	2	2	1	1
Q.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A.	2	3	1	4	3	1	3	3	4	1	2	4	3	3	1	4	2	3	4	4

PART-IV(A) : ENGLISH PROFICIENCY

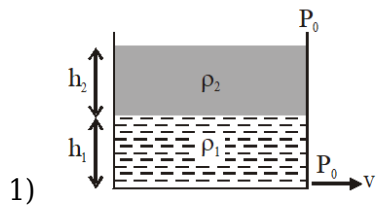
Q.	101	102	103	104	105	106	107	108	109	110
A.	2	3	1	2	3	4	1	4	3	4

PART-IV(B) : LOGICAL REASONING

Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	2	3	1	2	3	3	1	2	1	3	3	2	3	1	2	3	3	1	2	4

SOLUTIONS

PART-I : PHYSICS

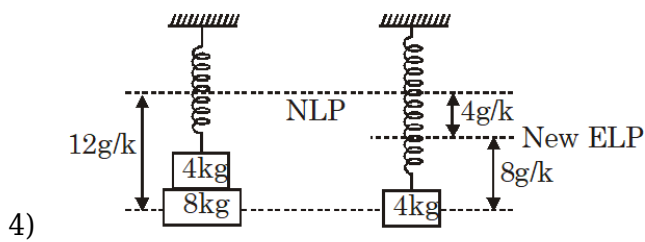


$$P_0 + h_1 \rho_1 g + h_2 \rho_2 g + 0 = P_0 + \frac{1}{2} \rho_1 v^2$$

$$v = \sqrt{2g \left(h_1 + \frac{h_2 \rho_2}{\rho_1} \right)}$$

2)

$$\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{K_2 \frac{A \epsilon_o}{2d}}{K_1 \frac{A \epsilon_o}{d}} = \frac{3}{2}$$



5) For 1-D motion

$$t = \frac{20}{2} = 10 \text{ sec}$$

For the part of SHM

$$\frac{T}{2} = \frac{2\pi}{2} \sqrt{\frac{M}{k}} = \pi \sqrt{\frac{1}{1}} = \pi$$

6)

$$T = \frac{m}{\ell} x g$$

$$Y = \frac{T dx}{A d\ell}$$

$$\Delta \ell = \int_0^\ell \frac{mgx dx}{\ell A}$$

$$2\Delta \ell = \int_0^\ell \frac{mgx dx}{\ell A}$$

$$\frac{AC}{BC} = \frac{\ell - x}{x} = \sqrt{2} - 1$$

$$7) Y_A = \tan 60^\circ$$

$$Y_B = \tan 30^\circ$$

$$Y_A \cdot Y_B = 1$$

$$\int_0^R \rho_0 (4\pi r^2 dr) = \pi \rho_0 R^4$$

8) Charge on sphere $Q = 0$

By definition of potential

$$V_{2R} - V_\infty = \frac{kQ}{2R}$$

$$V_\infty = -\frac{kQ}{2R} = -\frac{Q}{8\pi\epsilon_0 R}$$

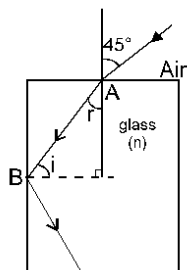
$$= -\frac{\rho_0 R^3}{8\epsilon_0}$$

11) diode acts is short circuit.

$$i = \frac{2}{80} A$$

$$12) \sin r = \frac{n_R}{n_D} = \frac{(C/v_R)}{(C/v_D)} = \frac{v_D}{v_R} = \frac{2 \times 10^8}{2.4 \times 10^8} = \frac{5}{6}$$

v_D & v_R : Velocity of light in denser & rarer medium respectively.



13)

For TIR at B, the angle of incidence $i > c$

$$\& \quad r + i = 90$$

$$i = 90 - r$$

by snell's law at pt A,

$$\sin 45^\circ = n \sin r = n \cos i$$

Now

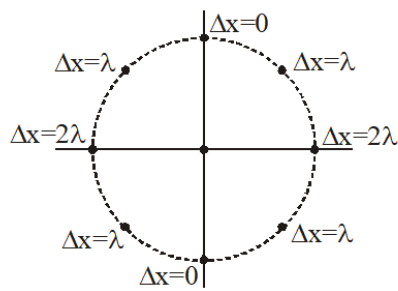
$$i > c$$

$$\sin i > \sin c$$

$$\Rightarrow \cos r > \frac{1}{n} \Rightarrow n > \frac{1}{\cos r}$$

$$\Rightarrow n > \frac{1}{\sqrt{1 - \sin^2 r}} \Rightarrow n > \frac{1}{\sqrt{1 - \frac{1}{n^2}}}$$

$$\Rightarrow n > \frac{\sqrt{2}n}{\sqrt{2n^2-1}} \Rightarrow 2n^2-1 > 2 \Rightarrow n > \sqrt{\frac{3}{2}}$$



14)

$$15) \text{ Loudness (in dB)} = 10 \log_{10} \left(\frac{I}{I_0} \right) = 10$$

$$I = 10 I_0$$

When all four sources are sounded together total intensity $I_{\max} = 4I = 40 I_0$

$$\text{Loudness in (dB)} = 10 \log_{10} \left(\frac{40I_0}{I_0} \right)$$

$$= 10 \log_{10}(40) \approx 16 \text{ dB}$$

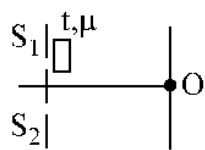
16) As amplitudes are A and 2A, so intensities would be in the ratio 1 : 4, let us say I and 4I.

$$I_{\max} = I_0 + I + 4I + 2\sqrt{4I^2} = 9I \Rightarrow I = \frac{I_0}{9}$$

Intensity at any point,

$$I' = I + 4I + 2\sqrt{4I^2}$$

$$\cos \phi; I' = 5I + 4I \cos \phi = \frac{I_0}{9} (5 + 4 \cos \phi)$$



17)

$$S_1O - S_2O = (\mu - 1)t$$

$$\Delta \phi = \frac{2\pi}{\lambda} (\mu - 1)t$$

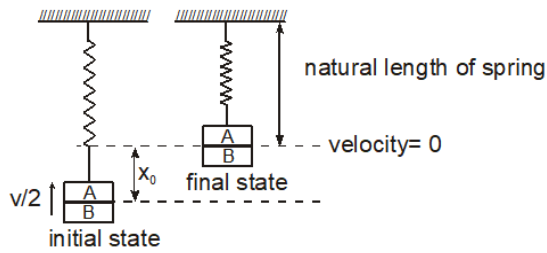
$$I = I_{\max} \cos^2 (\Delta/2)$$

$$I = I_0 \cos^2 \left(\frac{\pi (\mu - 1)t}{\lambda} \right)$$

$$19) I = \frac{Ma^2}{4} + \frac{Ma^2}{4} = \frac{Ma^2}{2}$$

$$I_O = I_c + M \left(\frac{a}{2} \sqrt{2} \right)^2$$

$$= \frac{Ma^2}{2} + \frac{Ma^2}{2} = Ma^2 = 2I$$



20)

The initial extension in spring is $x_0 = \frac{mg}{k}$

Just after collision of B with A the speed of combined mass is $\frac{v}{2}$

For the spring to just attain natural length the combined mass must rise up by $x_0 = \frac{mg}{k}$ (sec fig.) and comes to rest.

Applying conservation of energy between initial and final states

$$\frac{1}{2} 2m \left(\frac{v}{2} \right)^2 + \frac{1}{2} k \left(\frac{mg}{k} \right)^2 = 2mg \left(\frac{mg}{k} \right)$$

$$\text{Solving we get } v = \sqrt{\frac{6mg^2}{k}}$$

21) P will increase till $t = 5$, then P decrease

P is maximum at $t = 5$

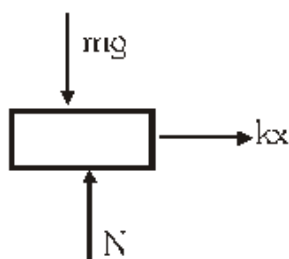
$$\int F dt = \Delta P$$

$$10 \times 5 = m (v_f - v_i)$$

$$50 = 2 (v - 2)$$

$$v = 27 \text{ m/s}$$

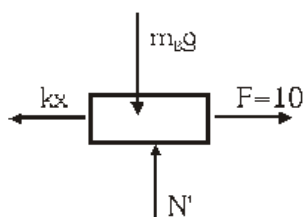
maximum speed



22)

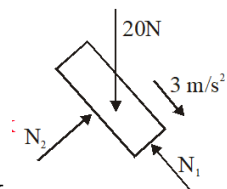
NLM on A

$$kx = m_A \times a_A = 2 \text{ N}$$



23) Acceleration of block is perpendicular to wedge and is equal to normal component of

acceleration of wedge i.e. 3 m/s^2



FBD of block

$N_1 = 10 \text{ Newton}$

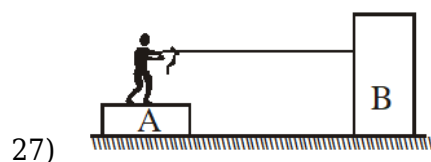
26) Time of flights

$$T_A = \frac{2u \sin \theta}{g} = \frac{2 \times 50 \times \frac{3}{5}}{10} = 6 \text{ s}$$

$$T_B = \frac{2 \times 30}{10} = 6 \text{ s}$$

$$T_C = \frac{2 \times 40 \times \frac{4}{5}}{10} = 6 \text{ s}$$

The balls can never meet as their highest points are at different level if all the three ball are projected simultaneously.



27)



$$a_1 = \frac{1}{5} \text{ m/s}^2$$

$$a_2 = \frac{1}{10} \text{ m/s}^2$$

$$v_1 = 5 \times \frac{1}{5} = 1 \text{ m/s}$$

$$v_2 = 5 \times \frac{1}{10} = \frac{1}{2} \text{ m/s}$$

$$v_{12} = 1.5 \text{ m/s}$$



29)

$$\text{Using ; } V_A - V_B = RI + L \frac{dI}{dt}$$

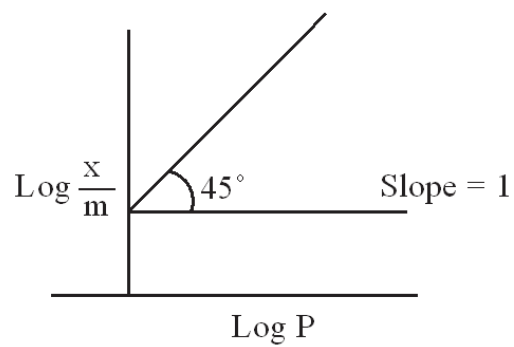
$$140 = 5R + 10 L$$

$$60 = 5R - 10 L$$

$$L = 4H.$$

$$\begin{aligned}
 48) \quad \Delta x \cdot \Delta P &= \frac{h}{4\pi} \\
 \frac{h}{P} \Delta P &= \frac{h}{4\pi} \\
 \frac{\Delta P}{P} &= \frac{1}{4 \times \pi} \\
 100 \times \frac{\Delta v}{v} &= \frac{1}{4 \times \pi} \times 100 \\
 &= 8 \%
 \end{aligned}$$

$$\begin{aligned}
 52) \quad \log \frac{x}{m} &= \log k + \frac{1}{n} \log P \\
 \square \quad \frac{1}{n} &= 1 \\
 n &= 1
 \end{aligned}$$



$$\text{and } \log K = 0.699$$

$$\begin{aligned}
 \square \quad K &= 5 \\
 \text{Now, } \frac{x}{m} &= k P^{\frac{1}{n}} \\
 \frac{x}{m} &= 5 \times (0.5)^1 \\
 &= 2.5
 \end{aligned}$$

PART-III : MATHEMATICS

$$61) \quad \vec{r} \cdot \vec{n} = d \quad \dots(1)$$

$$\vec{r} = \vec{r}_0 + t\vec{n} \quad \dots(2)$$

from (1) and (2)

$$(\vec{r}_0 + t\vec{n}) \cdot \vec{n} = d$$

$$t = \frac{d - \vec{r}_0 \cdot \vec{n}}{\vec{n}^2}$$

substitute the value of 't' in (2)

$$r = \vec{r}_0 + \left(\frac{d - \vec{r}_0 \cdot \vec{n}}{\vec{n}^2} \right) \vec{n}$$

$$62) \quad \begin{array}{c} \uparrow \qquad \qquad \downarrow \\ \text{-----} \\ \qquad \quad | \\ \qquad \quad x=2 \end{array}$$

$$f'(x) = -4 \cdot \frac{2}{3} \cdot (x-2)^{-1/3}$$

$$= \frac{-8}{3\sqrt[3]{x-2}}$$

$$\left. \begin{aligned} f'(x) < 0 & \quad \text{for } x < 2 \\ \text{and } f'(x) > 0 & \quad \text{for } x > 2 \end{aligned} \right\}$$

$x = 2$ is a point of maxima

$f(x)$ attains maximum value at $x = 2$

63) Equation of plane containing

$$\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$$

and point $(0, 7, -7)$ is

$$\begin{vmatrix} x+1 & y-3 & z+2 \\ -3 & 2 & 1 \\ -1 & -4 & 5 \end{vmatrix} = 0$$

By solving we get

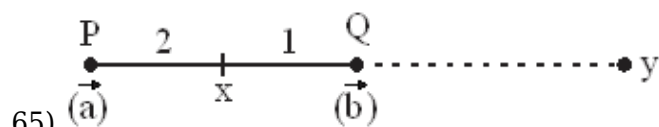
$$x + y + z = 0$$

64) Equation of plane containing L_1 and parallel to L_2 is

$$\begin{vmatrix} x-2 & y-1 & z+1 \\ 1 & 0 & 2 \\ 1 & 1 & -1 \end{vmatrix} = 0$$

$$2x - 3y - z = 2$$

$$\text{distance from origin} = \frac{2}{\sqrt{14}} = \sqrt{\frac{2}{7}}$$



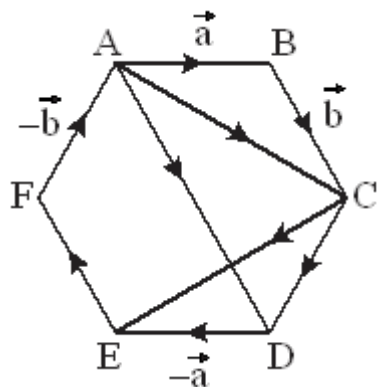
$$\overrightarrow{OX} = \frac{2\vec{b} + \vec{a}}{3}; \quad \overrightarrow{OY} = \frac{2\vec{b} - \vec{a}}{2-1} = 2\vec{b} - \vec{a}$$

$$\begin{aligned} \therefore \overrightarrow{XY} &= \overrightarrow{OY} - \overrightarrow{OX} \\ &= 2\vec{b} - \vec{a} - \left(\frac{2\vec{b} + \vec{a}}{3} \right) \\ \overrightarrow{XY} &= \frac{6\vec{a} - 3\vec{a} - 2\vec{b} - \vec{a}}{3} = \frac{4}{3}(\vec{b} - \vec{a}) \end{aligned}$$

$$\sum_{n=0}^{\infty} \cot^{-1}(2^{n+1} + 2^{-n})$$

$$= \sum_{n=0}^{\infty} \tan^{-1} \left(\frac{1}{2^{n+1} + 2^{-n}} \right)$$

$$\begin{aligned}
&= \sum \tan^{-1} \left(\frac{2^{n+1} - 2^n}{1 + 2^n \cdot 2^{n+1}} \right) \\
&= \sum_{n=0}^{\infty} \tan^{-1}(2^{n+1}) - \tan^{-1}(2^n) \\
&(\tan^{-1} 2 - \tan^{-1} 1) + (\tan^{-1} 4 - \tan^{-1} 2) + \dots \dots \infty \\
&= \frac{\pi}{2} - \tan^{-1}(1) = \frac{\pi}{4}
\end{aligned}$$



67)

$$\vec{AC} = \vec{a} + \vec{b}$$

$$\vec{AD} \text{ is parallel to } \vec{BC}; \vec{AD} = 2\vec{BC}$$

In $\triangle ACD$; $AC + CD = AD$;

$$a + b + CD = 2b$$

$$CD = 2b - a$$

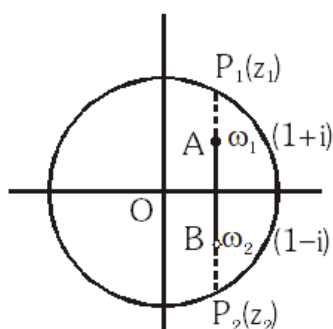
$$CE = CD + DE$$

$$CE = b - a + (-a) = b - 2a$$

68) $|PA - PB|$ is to be maximised when $P(z)$ moves on $|z| = 2$ and this is possible when P, A and B are collinear

P_1P_2 is a straight line parallel to y -axis whose equation is $x = 1$

Solving $x = 1$ with $|z| = 2$



we get $y = \pm\sqrt{3}$

$$z_1 = 1 + \sqrt{3}i$$

$$z_2 = 1 - \sqrt{3}i$$

$$z_1 z_2 = 4$$

69) As the point $(3\sqrt{3}, 2)$ lies on the line $y = \sqrt{3}x - 7$ so locus of P will be a line perpendicular to given line and passing through $(3\sqrt{3}, 2)$

$$y - 2 = -\frac{1}{\sqrt{3}}(x - 3\sqrt{3})$$

$$y - 2 = \frac{-x}{\sqrt{3}} + 3$$

$$\frac{x}{\sqrt{3}} + y - 5 = 0$$

It intersects x and y axis at $(5\sqrt{3}, 0)$ and $(0, 5)$ so area of the triangle formed

$$= \frac{5\sqrt{3} \times 5}{2} = \frac{25\sqrt{3}}{2}$$

$$70) \frac{dy}{dx} = e^x(\cos x - \sin x) = m \quad (\text{let})$$

$$\text{Now } \frac{dm}{dx} = -2e^x \sin x$$

$$\text{For } m \text{ to be max., } \frac{dm}{dx} = 0$$

$$\Rightarrow x = n\pi, n \in \mathbb{I}$$

$$\frac{d^2m}{dx^2} = -2e^x(\sin x + \cos x)$$

$$\text{At } x = 0, \frac{d^2m}{dx^2} < 0$$

$x = 0$ is a point of maxima

$$71) z_1 z_2 = i \lambda_1$$

$$\Rightarrow |z_1| |z_2| = |i| |\lambda_1|$$

$$|\lambda_1| = 1 \Rightarrow \lambda_1 = \pm 1$$

$$\frac{z_1}{z_2} = \lambda_2$$

$$\frac{|z_1|}{|z_2|} = |\lambda_2|$$

$$\Rightarrow |\lambda_2| = 1$$

$$\lambda_2 = \pm 1$$

$$\text{Take } \lambda_2 = 1 \Rightarrow z_1 = z_2$$

$$\lambda_1 = 1$$

$$z_1 z_2 = i \Rightarrow z_2^2 = i \quad (\text{Two values})$$

$$\lambda_2 = 1 \Rightarrow z_1 = z_2$$

$$\lambda_1 = -1 \Rightarrow z_2^2 = -i \quad (\text{Two values})$$

$$\lambda_2 = -1 \Rightarrow z_1 = -z_2$$

$$\lambda_1 = 1 \Rightarrow z_1 z_2 = i$$

$$\Rightarrow z_2^2 = -i \quad (\text{Two values})$$

$$\lambda_1 = -1 \quad z_1 = -z_2$$

$$\lambda_1 = -1 \quad z_2^2 = i \quad (\text{Two values})$$

Eight values

$$72) D \geq 0 \text{ \& } \frac{3a}{a+1} > 2$$

$$\text{\& } (a+1)(2a+1) > 0$$

$$\frac{-16}{7} \leq a \leq 0 \text{ \& } a < -1, a > 2 \text{ \& } a < -1, a > \frac{1}{2}$$

so $a \in \left[-\frac{16}{7}, -1\right)$

73) $\frac{1}{(b+c)} \log x, \log x^{\frac{1}{(c+a)}}, \log x^{(a+b)^{-1}}$ are in A.P.
 $= \frac{1}{(b+c)} \log x, \frac{1}{(c+a)} \log x, \frac{1}{(a+b)} \log x$ are in A.P.
 $\Rightarrow \frac{1}{(b+c)}, \frac{1}{(c+a)}, \frac{1}{(a+b)}$ are in A.P.

Multiple

$(a+b)(b+c)(c+a)$

$(a+b)(a+c), (a+b)(b+c), (c+a)(b+c)$ in A.P.

$a^2 + ab + bc + ca, b^2 + ab + bc + ca, c^2 + ab + bc + ca$ in A.P.

a^2, b^2, c^2 are in A.P.

74) $I = \int_1^{e^{35}} \frac{\pi \sin(\pi \ell n x)}{x} dx$
 $\pi \ell n x = t$
 $\frac{\pi}{x} dx = dt$
 $I = \int_0^{35\pi} \sin t dt = 2$

75) a, b, c are in A.P.

$\frac{a}{1-abc}, \frac{b}{1-abc}, \frac{c}{1-abc}$ are in A.P.

$\frac{a}{1-abc}, \frac{b}{1-abc}, \frac{c}{1-abc}$ are in H.P.

$\frac{1}{a-bc}, \frac{1}{b-ac}, \frac{1}{c-ab}$ are in H.P.

76) $f(x) = \int_1^{1/x} \left(\tan^{-1} \frac{1}{t} \right) \cdot t \cdot \left(\frac{-1}{t^2} \right) dt$ (Putting $x = \frac{1}{t}$)

$= - \int_1^{1/x} \frac{\tan^{-1}(1/t)}{t} dt$

$= - \int_1^{1/x} \frac{\cot^{-1} t}{t} dt = - \int_1^{1/x} \frac{\pi/2 - \tan^{-1} t}{t} dt$

$= \frac{\pi}{2} \ell n x + \int_1^{1/x} \frac{\tan^{-1} t}{t} dt$

or

$$f(x) - f\left(\frac{1}{x}\right) = \frac{\pi}{2} \ln x$$

$$\therefore \frac{f(e^3) - f(e^{-3})}{f(e) - f(e^{-1})} = 3$$

77) Equation of chord connecting the points $(a \sec \theta, b \tan \theta)$ and $(a \sec \phi, b \tan \phi)$ is

$$\frac{x}{a} \cos\left(\frac{\theta - \phi}{2}\right) - \frac{y}{b} \sin\left(\frac{\theta + \phi}{2}\right) = \cos\left(\frac{\theta + \phi}{2}\right) \quad \dots (i)$$

If it passes through $(ae, 0)$;

$$\text{we have, } e \cos\left(\frac{\theta - \phi}{2}\right) = \cos\left(\frac{\theta + \phi}{2}\right)$$

$$e = \frac{\cos\left(\frac{\theta + \phi}{2}\right)}{\cos\left(\frac{\theta - \phi}{2}\right)} = \frac{1 - \tan \frac{\theta}{2} \cdot \tan \frac{\phi}{2}}{1 + \tan \frac{\theta}{2} \cdot \tan \frac{\phi}{2}}$$

$$\tan \frac{\theta}{2} \cdot \tan \frac{\phi}{2} = \frac{1 - e}{1 + e}$$

Similarly if (i) passes through $(-ae, 0)$,

$$\tan \frac{\theta}{2} \cdot \tan \frac{\phi}{2} = \frac{1 + e}{1 - e}$$

79) India win atleast three matches

$$= {}^5C_3 \left(\frac{1}{2}\right)^5 + {}^5C_4 \left(\frac{1}{2}\right)^5 + {}^5C_5 \left(\frac{1}{2}\right)^5$$

$$= \left(\frac{1}{2}\right)^5 (16) = \frac{1}{2}$$

$$80) y = \frac{16}{x} \Rightarrow \frac{dy}{dx} = -\frac{16}{x^2} = -\frac{1}{4}$$

slope of normal = 4

Equation of normal is $y - 2 = 4(x - 8)$

$$y = 4x - 30$$

$$(4x - 30)x = 16$$

$$4x^2 - 30x - 16 = 0$$

$$x = 8 \text{ or } -\frac{1}{2}$$

$$\text{Point } \left(-\frac{1}{2}, -32\right)$$

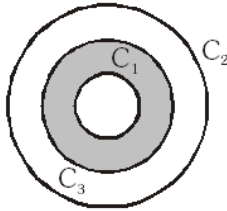
$$\tan \theta_1 = \frac{1}{4}$$

$$\tan \theta_2 = 64$$

Angle between the line is

$$\tan \theta = \left| \frac{64 - \frac{1}{4}}{1 + 64 \cdot \frac{1}{4}} \right| = \left| \frac{255}{68} \right|$$

$$= \left| \frac{15}{4} \right|$$



81)

Required probability

$$= \frac{\text{Area outside } C_1 \text{ \& inside } C_3}{\text{Area outside } C_1 \text{ \& inside } C_2}$$

$$= \frac{\pi(9-4)}{\pi(16-4)} = \frac{5}{12}$$

83) $\int \left(2x + \frac{1}{x}\right) \cos \frac{1}{x} dx$

$$\int x \cdot \cos \frac{1}{x} dx$$

$$= \cos \frac{1}{x} \cdot \frac{x^2}{2} - \int \sin \frac{1}{x} \cdot \frac{1}{x^2} \cdot \frac{x^2}{2} dx$$

$$= \frac{x^2}{2} \cdot \cos \frac{1}{x} - \frac{1}{2} \int \sin \frac{1}{x} dx$$

$$= \frac{x^2}{2} \cdot \cos \frac{1}{x} - \frac{1}{2} \left[x \cdot \sin \frac{1}{x} + \int \cos \frac{1}{x} \cdot \frac{1}{x^2} \cdot x dx \right]$$

$$= \frac{x^2}{2} \cdot \cos \frac{1}{x} - \frac{x}{2} \sin \frac{1}{x} - \frac{1}{2} \int \frac{1}{x} \cos \frac{1}{x} dx$$

$$\int \left(2x + \frac{1}{x}\right) \cos \frac{1}{x} dx = x^2 \cos \frac{1}{x} - x \sin \frac{1}{x} - \int \frac{1}{x} \cos \frac{1}{x} dx + \int \frac{1}{x} \cos \frac{1}{x} dx$$

$$= \int \left(2x + \frac{1}{x}\right) \cos \frac{1}{x} dx = x^2 \cos \frac{1}{x} - x \sin \frac{1}{x}$$

84) $y = \frac{ax + b}{cx + d}$

The inverse function is

$$= \frac{dy - b}{a - cy}$$

Equating the two we get $a + d = 0$.

85) $\int \underbrace{x^2}_I \underbrace{\frac{x \sec^2 x + \tan x}{(x \tan x + 1)^2}}_{II} dx$

$$= -\frac{x^2}{x \tan x + 1} + 2 \int \frac{x \cos x}{x \sin x + \cos x} dx$$

$$= \frac{-x^2}{1 + x \tan x} + 2 \ln |x \sin x + \cos x| + C$$

86) $x = 1$ is a root of the equation

$D = 0$

$$\Rightarrow \frac{-b}{2a} = 1 \Rightarrow \frac{r-q}{2p-2q} = 1$$

$$r - q = 2p - 2q$$

$$2p - q - r = 0$$

$$-2p + q + r = 0$$

$$px + qy + r = 0$$

always passes through $(-2, 1)$

$$87) \text{ Since } \sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$$

$$I = \int \frac{\pi}{2} dx = \frac{\pi}{2} x = C$$

$$88) \vec{a} \cdot \vec{b} = 0$$

$$x_1 - 2x_2 + x_3 = 0$$

$$x_1 + x_3 = 2x_2$$

x_1, x_2, x_3 are selected from the set

$\{1, 2, 3, \dots, 10\}$,

Case-I :

1, 3, 5, 7, 9 = 5 numbers

2, 4, 6, 8, 10 = 5 numbers

3 numbers in A.P. can be selected by

$${}^5C_2 + {}^5C_2 = 20 \text{ ways.}$$

In each way x_1 & x_3 can be interchanged

Number of required triplets are

$$2 \times 20 = 40$$

Case-II :

When numbers are equal $x_1 = x_2 = x_3$ then number of triplets = 10

Hence number of vectors $\vec{a}$ are

$$40 + 10 = 50$$

$$89) (x^2 - 1)^6 = 0 \text{ has roots } -1 \text{ and } +1 \text{ each repeated 6 times.}$$

$$\frac{d}{dx}(x^2 - 1)^6 = 0$$

has roots -1 and $+1$ each repeated 5 times and there is a root 0 between -1 and $+1$.

Using Rolle's theorem

$$\frac{d^2}{dx^2}(x^2 - 1)^6 = 0$$

has roots -1 and $+1$ each repeated 4 times and there are two distinct roots between -1 and 0 & 0 and 1 .

Similarly, it can be concluded that $\frac{d^6}{dx^6}(x^2 - 1)^6 = 0$ has all real and distinct roots between -1 and $+1$.

$$90) \text{ H } \quad \text{A} \quad \text{D} \quad \text{I} \quad \text{P}$$

$$1 \quad 2 \quad 2 \quad 1 \quad 2$$

same as HONOLULU

$$\begin{aligned}
 & 92) \frac{a}{e} - ae \\
 & \Rightarrow \frac{r!(5-r)!}{5!} + \frac{r!(6-r)!}{6!} = \frac{r!(4-r)!}{4!} \\
 & \Rightarrow \frac{(5-r)!}{5!} + \frac{(6-r)!(5-r)!}{6!} = 1 \\
 & \Rightarrow \frac{5}{5!} + \frac{30}{6!} = 1 \\
 & \Rightarrow r^2 - 11r + 30 + 30 - 6r = 30 \\
 & \Rightarrow r^2 - 17r + 30 = 0 \therefore \boxed{r=2} \text{ or } 15 \text{ (Reject)}
 \end{aligned}$$

$$\begin{aligned}
 & 93) \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} \\
 & = -(a+b+c)(a^2 + b^2 + c^2 - ab - bc - ac) \\
 & \text{which is negative for distinct positive } a, b \text{ and } c.
 \end{aligned}$$

$$\begin{aligned}
 & 94) x - 2y + 5z = 3 \\
 & 2x - y + z = 1 \\
 & 11x - 7y + pz = q \\
 & \Delta = 0 \Rightarrow \begin{vmatrix} 1 & -2 & 5 \\ 2 & -1 & 1 \\ 11 & -7 & p \end{vmatrix} = 0 \\
 & (-p + 7) + 2(2p - 11) + 5(-14 + 11) = 0 \\
 & p = 10 \\
 & \Delta_x = 0 \Rightarrow \begin{vmatrix} 3 & 2 & 5 \\ 1 & 1 & 1 \\ q & 7 & 10 \end{vmatrix} = 0 \\
 & 3(10 - 7) - 2(10 - q) + 5(7 - q) = 0 \\
 & q = 8 \\
 & p - q = 2
 \end{aligned}$$

$$\begin{aligned}
 & 95) \det((3AC)(2B)^{-1}) = |3AC| \cdot |(2B)^{-1}| \\
 & = 9|A| \cdot |C| \cdot \left| \frac{1}{2} \cdot B^{-1} \right| \\
 & = 9|A| \cdot |C| \cdot \frac{1}{4} \cdot \frac{1}{|B|} \\
 & = 9 \cdot \frac{1}{4} \cdot 2 \cdot \frac{1}{4} \cdot \frac{1}{9} \\
 & = \frac{1}{8}
 \end{aligned}$$

$$96) \text{ Let } A_i = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 4 \end{bmatrix}$$

or

$$\begin{bmatrix} a^2 + bc & ab + bd \\ ac + cd & bc + d^2 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 4 \end{bmatrix}$$

$$a^2 + bc = 1, (a + d)b = 2,$$

$$(a + d)c = 0, bc + d^2 = 4$$

$$c = 0, a^2 = 1, d^2 = 4, (a + d)b = 2$$

4 possible sets of a, b, c, d are possible

$$\text{Hence } A_i \text{ are } \begin{bmatrix} 1 & 2/3 \\ 0 & 2 \end{bmatrix}, \begin{bmatrix} 1 & -2 \\ 0 & -2 \end{bmatrix}, \begin{bmatrix} -1 & 2 \\ 0 & 2 \end{bmatrix}, \begin{bmatrix} -1 & -2/3 \\ 0 & -2 \end{bmatrix}$$

$$\sum_{i=1}^4 \det(A_i) = 2 - 2 - 2 + 2 = 0$$

$$\begin{aligned} 97) \quad & \lim_{x \rightarrow \infty} x^2 \cdot \left(\sqrt{1 + \frac{a^2}{x^2}} - \sqrt{1 + \frac{a^4}{x^4}} \right) \\ &= \lim_{x \rightarrow \infty} x^2 \left[\left\{ 1 + \frac{1}{2} \frac{a^2}{x^2} + \frac{\frac{1}{2} \left(\frac{1}{2} - 1 \right)}{2!} \cdot \frac{a^4}{x^4} + \dots \right\} - \left\{ 1 + \frac{1}{2} \frac{a^4}{x^4} + \dots \right\} \right] \\ &= \frac{a^2}{2} \end{aligned}$$

$$98) y = \cos kx$$

$$y_1 = -k \sin kx$$

$$y_2 = -k^2 \cos kx$$

$$y_3 = k^3 \sin kx$$

$$y_4 = k^4 \cos kx$$

.

.

.

Now the given matrix becomes

$$\begin{bmatrix} \cos kx & -k \sin kx & -k^2 \cos kx \\ k^8 \cos kx & -k^9 \sin kx & -k^{10} \sin kx \\ -k^{14} \cos kx & k^{15} \sin kx & k^{16} \cos kx \end{bmatrix}$$

Here, R_3 is $-k^{14}R_1$ then obviously value of the determinant corresponding to above matrix is zero.

$$\begin{aligned} 99) \quad & \lim_{n \rightarrow \infty} n \left(\sec^2 \frac{\pi}{4n} \right) \cos^3 \frac{\pi}{4n} \sin \frac{\pi}{4n} \\ & \frac{n}{2} \sin \left(\frac{\pi}{2n} \right) = \lim_{n \rightarrow \infty} \frac{\sin \left(\frac{\pi}{2n} \right)}{2 \frac{1}{n}} \end{aligned}$$

$$= \frac{\sin\left(\frac{\pi}{2n}\right)}{2\frac{\pi}{2n}} \times \frac{\pi}{2} = \frac{\pi}{4}$$

100) f(x) is continuous in [-2, 3] & derivable in (-2, 3) so Rolle's theorem is applicable.

so $\exists c \in (-2, 3)$ such that $f'(c) = 0$

$$\Rightarrow \frac{2c^3 - 5c^2 + 4c - 1}{(c-1)^2} = 0$$

$$\Rightarrow c = 1/2$$

PART-IV(A) : ENGLISH PROFICIENCY

101) Explanation : Option 'b' is the correct answer because when selection is to be made between more than two things/persons, superlative degree is used. The structure will be- The+ superlative degree+ of all the...

102) Explanation : Option 'c' is correct because Only two similar things/ of same weightage can be compared. For example- 'Ambani's property with Tata's sounds ambiguous because we can only compare their properties i.e. Ambani's property with Tata's property.

103) Explanation : Option '1' is correct because to maintain the parallel structure, all the actions mentioned should be in similar tense.

104) Explanation : Option 'b' is correct because to maintain the parallel structure, all the actions/verbs/nouns mentioned should be in similar tense. The sentence uses preposition in every part, hence the parallelism of prepositions must be maintained.

105) Explanation : Option 'c' is the correct answer. Every nation has a heraldic device or symbolic object as a distinctive badge of a nation that is known as Emblem. In the same way every organization also has a 'Logo'.

106) Explanation : Option'd' is the correct answer because as library demands silence, poetry demands rhyme

107) Explanation : Option 'a' is the correct answer.

108) Explanation : Option '4' is the correct answer

109) Explanation : Option '3' is the correct answer.

PART-IV(B) : LOGICAL REASONING

111) Explanation :

H (7 position ahead) =O

E (4 position backward) =A

L (7 position ahead) =S

L (4 position backward) =H

O (7 position ahead) =V

P (7 position ahead) =W

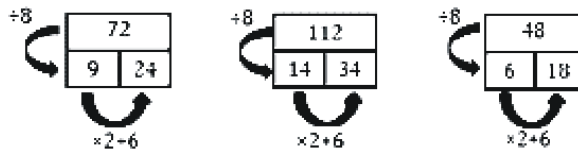
A (4 position backward) =W

R (7 position ahead) =Y

I (4 position backward) =E

S (7 position ahead) =Z

112) Explanation :

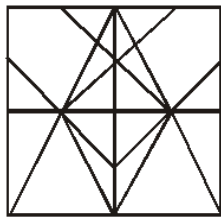


113)

Explanation : Option 1 is correct.

114) Explanation : While 'Indian' refers to the people who are native of India, all others are the names of languages. Therefore Option 2 is incorrect.

115) Explanation : Option 2 is correct.



116) Explanation : Each block in a column has different facial features. Therefore Option 3 is correct.

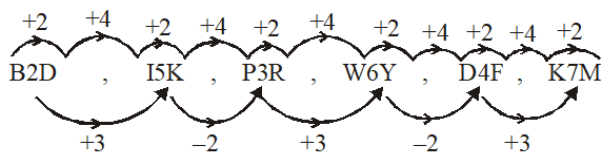
118) Explanation :

Multiplication of the numeric values of the alphabet pair at each of the sides will give you the number close to it.

18 (Numeric value of R) x 1 (Numeric value of A) = 18

Therefore Option B is correct.

119) Explanation: Option 1 is correct.



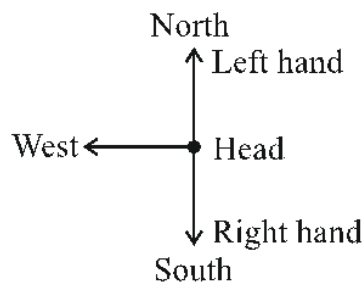
120)

121) Epigene, Epilogue, Episode, Epitaxy, Epitome.

122) $\frac{81}{9} = 9$; $9 \times 2 = 18$

123) $(10 \times 4) + (4 \times 4) - 6 = 40 + 16 - 6$
 $= 50$

Using BODMAS

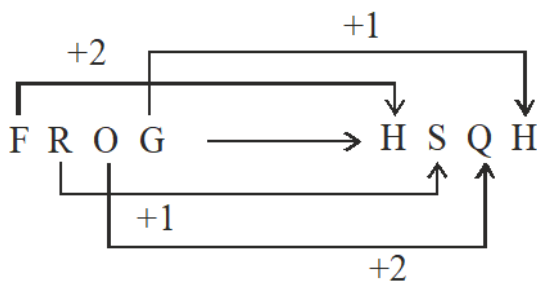


124)

125) Moving clockwise we get the sequence :

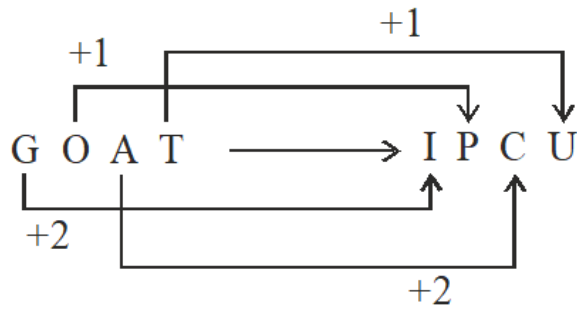
$1^2, 2^3, 3^2, 4^3, 5^2, 6^3$

So the answer is $6^3 = 216$

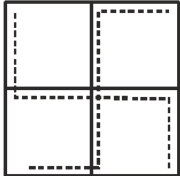


126)

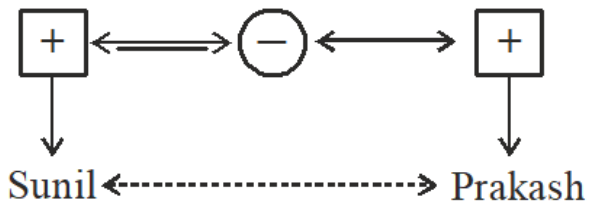
Similarly,



127) Embedded figure is shown with dotted line.

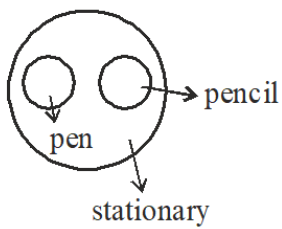


128) Following family tree is possible



Sunil and Prakash are cousins.

129) Multiply by 25



130)

All pens and all pencils are items of stationary.